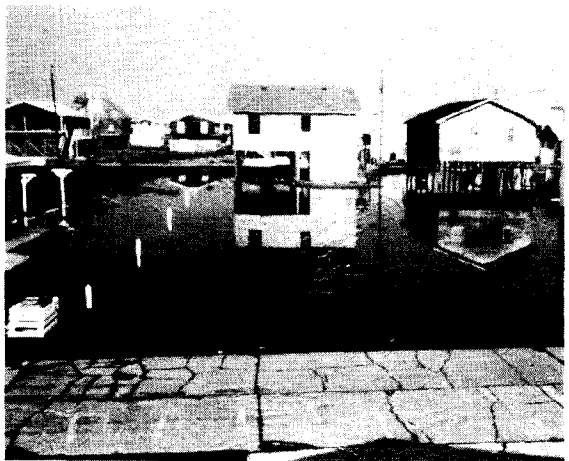


North Carolina Coastal Zone Management Program

STORM WATER MANAGEMENT PLAN FOR THE TOWN OF COASTAL ZONE KILL INFORMATION CENTER DEVIL HILLS

DARE CO., NORTH CAROLINA



TD
665
.N6
S7
1983

IV :

B McDOWELL & ASSOCIATES, P.A.
ENGINEERS & SURVEYORS
Post Office Box 391
303 E. Main Street, Suite 8
Elizabeth City, N. C. 27909

MAY, 1983

THE PREPARATION OF THIS REPORT (MAPS) WAS FINANCED IN PART THRU A GRANT PROVIDED BY THE NORTH CAROLINA COASTAL MANAGEMENT PROGRAM THRU FUNDS PROVIDED BY THE COASTAL ZONE MANAGEMENT ACT 1972 AS AMENDED WHICH IS ADMINISTERED BY THE OFFICE OF COASTAL ZONE MANAGEMENT NATIONAL OCEANIC ATMOSPHERIC ADMINISTRATION.

STORM WATER MANAGEMENT PLAN
FOR
THE TOWN OF KILL DEVIL HILLS
NORTH CAROLINA

Prepared by:
McDowell & Associates, P.A.
Engineers-Surveyors
Box 391
Elizabeth City, N.C.
May 1983

TD 664. N6 S7 1983 C.1

TABLE OF CONTENTS

<u>Section</u>	<u>Pages</u>
I. Introduction	2
II. Existing Physical Characteristics	5
1. Topography	
2. Climate	
3. Soils	
III. Inventory of Existing Facilities	6
IV. Design Criteria and Standards	3
V. Recommendations, Costs, and Priorities	2
<u>Appendix</u>	
Figure A: Map - Existing Drainage Facilities, Problem Areas, and Proposed Drainage Improvements	Back Packet
Figure B: Photo Index	4
Figure C: Photographs	18
Figure D: Summary of Problem Areas with Proposed Solutions	14
Figure E: References	2

STORM WATER MANAGEMENT PLAN

I. INTRODUCTION:

During the time this report has been prepared from September, 1982 to May 1983 there have been numerous rainfalls which due to their accumulative affect have accented potential drainage problem areas that have been dormant for some time. In the last 20 years there have been no major storm events (hurricanes) and the last 5-10 years have been relatively dry permitting the ground water in the area to lower. This dry period has permitted infiltration of rainwater to be maximized and helped to minimize the potential detrimental effects of poorly maintained drainage systems. This situation also tended to encourage developments with no formal drainage systems; ie, all drainage would be vertical or infiltrate into the sand as opposed to draining into a ditch or pipe system which in turns flows to a positive outlet to the Sound or Ocean. The purpose of this plan is to evaluate these problems as well as accomplish the following objectives:

1. To identify current surface water drainage problems.
2. To anticipate future drainage problems in Kill Devil Hills.
3. To help guide growth in an orderly manner consistant with the Town's Land Development Plan.
4. To help prevent the loss of life and property as the result of drainage problems.

5. To help reduce existing and future maintenance and capital cost for the necessary storm water drainage systems in and around the Town.
6. To help coordinate associated regulations as soil erosion and flood plain management.
7. To assist the Town to set up cooperative agreements with the North Carolina Department of Transportation (N.C.D.O.T.) in protecting and maintaining the area's drainage system.

This data has been generated through collation of the following sources:

1. Ground topographic surveys and photographs.
2. Aerial photographs.
3. Interviews with Town officials, North Carolina Department of Transportation officials, local Soil Conservation Service officials, Corps of Engineers, and local citizens.
4. Existing Coast and Geodetic mapping.
5. Flood Insurance Rate Map; U.S. Department of Housing and Urban Development.
6. Weather Bureau data from U.S. Department of Commerce (N.O.A.A.)
7. Hydrological and hydraulic analysis based on standard engineering procedures.
8. Current Town ordinances, planning documents and standards.

II. EXISTING PHYSICAL CHARACTERISTICS

1. Topographic Features:

The Town of Kill Devil Hills is located on the Outer Banks/ Barrier Islands of North Carolina. It is bounded on the east by the Atlantic Ocean and on the west by the Roanoke Sound. Elevations range from sea level to 60 feet above in the Nature Conservancy Woods area. The more common elevations tend to range from elevation 5 to 12. There are two primary dune systems which affect the drainage patterns within the Town. The primary dune line along the Ocean and east of U.S. 158 business requires special pipe systems on piles and flap gates to permit drainage to the Ocean. The dune line west of U.S. 158 Bypass or along the Sound creates problems for ditch or pipe systems which must be cut through it to drain low areas behind or east of this dune line. These problems relate to depth of cut and stabilizing and maintaining ditches from wind blown sand.

The two major north-south roads - U.S. 158 Business and U.S. 158 Bypass provide obstacles also because the normal drainage outlets must flow east to the Ocean Outfalls or west to the Sound and therefore must go under these two roads.

Due to the flatness of a large part of the land between the two dune structures and the high groundwater table in poor soil areas, large ditches with very flat slopes are required to

be built to drain these areas. These ditches are typical of the backbone drainage system for drainage north and south between U.S. 158 business and bypass as well as the Sound outlets at the north end of Town and west of U.S. 158 bypass.

2. CLIMATE

The area enjoys a maritime climate with cooler summers and warmer winters than are to be found on the mainland. Weather data for the region is provided by the U.S. National Oceanic and Atmospheric Administration (NOAA) at Cape Hatteras, approximately 50 miles south of Nags Head. General climatic conditions in the study area are closely approximate to those at Cape Hatteras except that annual precipitation is slightly less. Rainfall at Hatteras, with an annual mean of 55.07 inches, is five inches more than annual rainfall at Bodie Island. The wettest months are normally July and August, when there is a monthly average of nine days with thunderstorms.

The mean annual temperature at Hatteras is 61.4 degrees F. The prevailing winds blow from the northeast in fall and winter, and from the southwest in spring and summer. Hurricanes are fairly frequent along the Outer Banks, and occur mainly in August and September. Average annual runoff in the area is about 14 inches. Evapotranspiration average about 36 inches, and ground water discharge is about .5 inches.

Flood levels for Kill Devil Hills are 8.2 feet for a 50 year storm and 8.8 feet for a 100 year storm. Investigations relating to flood insurance studies show that overwash of the island by ocean tides would be sufficient to cause a 100 year flood level on the Sound shore equal to the static ocean level.

3. SOILS

The soils in Kill Devil Hills play an important role in the nature of the storm water drainage system. The soil has a tremendous capability to detain and retain surface water run-off. The sandy soils also have the capability of neutralizing conventional underground storm sewer systems and ditches, because of its ability to wash and blow into the systems creating a perpetual maintenance problem.

A typical profile of soil units in Kill Devil Hills looks as follows:

<u>Location</u>	<u>Soil Unit</u>	<u>Depth</u>	<u>Perm.</u>	<u>Use</u>
Frontal dune	Beach-foredune assoc.	0-6'	Rapid	VSevere
Beach road east	Newhan fine	6'	VRapid	Slight
and between	Newhan Corolla	(See qualification)		
highways	Duckston fine sand	0-2'	VRapid	Severe
Bypass west	Duneland	6'	VRapid	Severe
	Duckston fine sand		(see above)	
	Newland fine sand		(see above)	
	Corolla fine sand	0-3'	VRapid	Severe
Soundside	Carteret soils	0-3'	Rapid	VSevere

(note: "Depth" refers to depth to seasonal high water table; "Perm." refers to permeability; "Use" refers to suitability for septic tank and filter field; "V" before Rapid and Severe means "very").

Two soils which create drainage problems because of their high ground water are Corolla-Duckston complex and Duckston Fine Sand. They are characterized below and are shown on the map in Figure "A".

A. Corolla-Duckston Complex

This mapping unit occurs on nearly level to slightly depressional areas that commonly lie just inland from the frontal dune. The Duckston soils are in the wetter, slightly lower depressions. The seasonal high water table is at or near the surface during the wet periods. Most of this complex is made up of the Corolla soils.

B. Duckston Fine Sand

The soils are poorly drained. The soils are sandy throughout. They occupy the nearly level to slightly depressional flats that extend inland from the frontal dunes. Also, they are in the small, irregularly shaped depressions between the Corolla and Newhan soils. They are rated severe for most uses due to wetness and poor filtering capacity. Water tables are 1.0' - 2.0'.

Another observation that should be made at this point is the impact of the soils on storm water quality. As reflected above the soils are typically permeable down to the water table; in fact, to the extent that they do not provide appropriate filtering characteristics for septic tank nitrification fields. The significance of this characteristic is that the local Health Department is requiring a 25 foot buffer between the drain field and ditches. A regional sewage collection and treatment system would alleviate this problem but would tend to aggravate the drainage problem. Development density would probably increase and generate more storm water runoff due to the increase in impervious area. Proper planning and regulation will need to be implemented to prevent this potential drainage problem from occurring.

III. INVENTORY OF EXISTING FACILITIES

The purpose of this section is to identify the major drainage features which influence the drainage capabilities of the land within the corporate limits of the Town. To assist in presenting this data we have provided one map (figure A), photographs (figure C) as well as a table (figure D) with a summary of problem areas prioritized and preliminary cost estimates for major items.

In general the conveyance of stormwater in Kill Devil Hills is predominately by ditches and corrugated metal pipe culverts with few conventional long storm sewer systems. Due to the two dune systems and flatness mentioned earlier the natural drainage is either vertical or to a general low area between U.S. 158 business and bypass where the existing north - south ditch system is located. Some areas north of the Town's Municipal Building and west of U.S. 158 bypass have natural drainage to the Sound. These areas are basically along the Sound or west of the dune system.

The map (figure A) shows problem areas, photographed areas, major drainage systems, and problem soil areas. An attempt has been made to approximate drainage areas without topographic mapping. These areas have been given designations with "S" or "O" prefixes with numbers. The prefix "S"

means that this apparent drainage area flows overland into a ditch or pipe system that flows to the Sound. The "O" prefix means the outlet is an ocean outfall.

For the most part the positive drainage that exists now has been developed through the construction of ditches since the natural topography does not provide continuous swales or low areas which drain to the Sound or Ocean. In a sense the drainage has been artificially developed by man with the location normally within existing low or wet soil areas.

There are three existing outfalls which drain the area of Town south of the Kill Devil Hills Post Office. The rest of the Town that has positive drainage drains to the Sound through 4 sound outlets of various sizes with the two primary outlets being the canal in S-8 and the Bickett Street ditch draining S-1 which includes the Avalon Beach area.

The problems that we have defined usually fall into two major categories. One category is lack of maintenance on existing systems and the other category relates to poor drainage because no formal system has ever been constructed in that area. We have provided numerous examples of each category in figure B,C and figure D.

The area which has received probably the most public attention is the area around the fresh water pond at the southern Town limits. In fact the pond straddles the Kill Devil Hills/

Nags Head Corporate Limits. A combination of generally dry weather for the past 10 years and the use of the pond as a potable water source had lowered the pond level and the companion watertable adjacent to it to permit a "drying out" of soils which have historically been categorized as potentially wet soils. When the wet weather returned this year along with the discontinuation of the use of the pond as a water source, the watertable rose to its normal historical high level eliminating vertical drainage and causing ponding on the ground surface within the subdivisions that had been developed in this area. Because of the large area involved and no positive outlet to service this area, ponding remained for an extensive period of time. The relationship of some of the homes to the streets have also aggravated the problem because their ground elevation and finish floor elevation are lower than the streets, therefore water runs off the streets into their yards and homes with no place to go. Even with standard roadside swales some yards will need to be filled to permit them to drain to a positive outlet.

Besides the Ocean Acres area there are numerous other areas as shown on the map which suffered from ponding due to high watertables in soils which have typically been described as potentially wet soils by the SCS. In particular Avalon Beach area in the "S-1" basin and a number of the problem areas west of U.S. 158 Bypass and north of the Town's Municipal building. The severity

of these problems were mitigated by either no one living in the homes or the area being sparsely developed during the major flooding period. One primary concern is the effect on the septic tank systems. Lack of drainage and/or high ground water conditions can compromise the septic tank system and therefore create health problems. While Ocean Acres does not have septic tank systems concern for excessive water entering the sewage collection system must be dealt with.

Ocean outfalls if properly constructed function well, but if they are not built on piles and extended above the ocean floor then they become a maintenance nightmare. Photo No. 50 shows an outfall properly constructed just north of the Sea Shore Shops. Problems of incorrect construction are shown in photos 51 & 52 which reflect the maintenance problems of the Baum St. outfall which typifies the problems of the outfall under Tanya's Ocean House also.

Additional concerns relative to drainage include the impact of widening U.S. 158 Bypass and the accelerated deterioration of the existing street systems because of ponding water and saturated road subgrades. Historically developments along the bypass have dumped their water into the right-of-way. See photos 45-48. Photos 33 and 34 show what happens when this

approach is abused. When these areas fill up they become a traffic hazard and nuisance because there is no place for the water to drain. As development and widening increases along the bypass careful consideration must be given to design proper drainage outlets. Photos 39,41,42,&43 show the dramatic impact poor drainage can have on road systems.

A final comment on problems relates to administrative procedures. Lack of coordination on development procedures standards, and ordinance as well as a maintenance agreement with the North Carolina Department of Transportation has hindered the orderly development of the drainage systems within the Town of Hill Devil Hills. In the past many of the facilities were installed to take care of current specific problems without regard to the community as a whole or future development.

Although some drainage systems are owned and maintained by the Town, and others by the State Department of Transportation, in many instances responsibilities for surface drainage facility construction and maintenance are poorly defined or acted upon, and therefore drainage problems remain unresolved.

The rapid development of certain areas of the Town will intensify the surface drainage problems in those areas. Development of areas which were formerly permeable increases both the total runoff and the rate of runoff. This not only establishes the demand for additional storm drainage facilities in the developing areas, but may well place a burden on the

areas at the end of the system. In many cases, this extra burden may increase the volume to a point which exceeds the capacity of those areas. As always, the correction of conditions is far more expensive than the cost of a properly planned and designed system based not only on the immediate needs, but also potential future growth.

IV. STORMWATER DRAINAGE DESIGN AND CONSTRUCTION CRITERIA

The following data outlines procedures for establishing appropriate design and construction guidelines within the Town.

1. The developer shall provide a drainage system for the proper drainage of all surface water using the approved design criteria as stated in the following paragraphs below. The design of such a system shall be subject to the approval of the Town pursuant to these guidelines and to the North Carolina Department of Transportation when the proposed drainage system affects drainage coming from or going into the State's Right-of-Way.
2. All surface water draining onto the site under development or generated on said site must be provided for in accordance with these guidelines. All water drainage leaving the site under development shall be channelled to points of approved discharge, such as a natural or manmade watercourse, a lake, pond, ditch or storm drainage system.
3. No surface water shall be channelled or directed into a sanitary sewer or septic tank system. Distances between open ditches and septic tank systems must be specified and approved by the Dare County Sanitarian. This approval must be obtained by the developer prior to final approval of the drainage system designed by the Town of Kill Devil Hills.

4. The developer shall use retention, detention, and infiltration techniques to reduce the runoff from his site.
5. The drainage design criteria for open and closed drainage systems shall generally conform to these guidelines and Handbook of Design for Highway Surface Drainage Structures prepared by the North Carolina Department of Transportation, the A.S.C.E. Manual of Engineering Practice No. 37, and Urban Hydrology for Small Watersheds (T.R. No. 55) prepared by the Soil Conservation Service.
6. Development plans shall show size, slope, invert and rim elevations, and ditch cross sections in the vicinity of the development and as is necessary to properly evaluate the existing and proposed surface water drainage system.
7. Drainage calculations, drainage area maps, flood routing calculations, infiltration calculations, storm sewer back water curve calculations, etc. shall be submitted to the Town upon request.
8. Estimated runoff calculations may be computed by the Rational Method ($Q=CIA$), the SCS method in TR No. 55, or other approved methodologies. Sizing of structures will be based on the Manning Equation. Culverts shall be evaluated for inlet and outlet control as necessary.
9. Systems shall generally be designed for a 10 year storm

frequency. There may be some situations which may warrant a different requirement due to the size of the system. The design engineer is encouraged to contact the Town Engineer in the preliminary design stages to determine if a change is warranted.

10. A modified Rational Method hydrograph procedure may be used in sizing retention and detention systems.
11. All underground storm sewers open drainage ways, and related structures shall be constructed to the applicable provisions of Roadway Standard Drawings and Standard Specifications for Road and Structures produced by the North Carolina Department of Transportation.
12. During the construction, preparation, arrangement and installation of improvements and facilities in developments, the developer shall maintain each stream, creek, ditch, or channel contiguous to or located within the subdivision in an unobstructed state and shall remove from such watercourses and the banks of the watercourses all debris, logs, timber, junk and other accumulations that would, in time of flood, clog or dam the passage of waters in their downstream course. Installation of appropriately sized conduit, culverts, bridges or other required structures shall not be constructed in a way which will obstruct the flow of drainage.

V. RECOMMENDATIONS, COSTS, AND PRIORITIES

We have identified a number of drainage related problems within the Town of Kill Devil Hills. Solutions to these problems require maintenance, new construction, coordination with D.O.T., S.C.S, and the creation of certain standards and ordinances.

Specific problems in the field have been identified and proposed generalized solutions with preliminary cost estimate have been reflected in table figure D. We prioritized 13 of the major problem areas with the cost estimates not including utility conflicts or easement acquisition. Since these solutions are generalized, detail designs would be needed to prepare plans and specifications as well as detailed cost estimates. The following table outlines the cross reference between the problem priority and the problem reference number on the map figure A and table figure D.

<u>Priority</u>	<u>Map reference No.</u>	<u>Priority</u>	<u>Map reference No.</u>
1	46	8	27
2	13	9	21
3	1	10	16
4	18	11	14
5	23	12	15
6	35	13	17
7	19		

In summary the following goals should be pursued:

1. Review the referenced field problems and set up the Town's priorities on corrective action using this report's priorities as a guide.
2. Establish sources of financing for corrective action through property owner assessments, developer requirements, general taxes, joint venture arrangements with D.O.T., and mosquito control funds.
3. Establish lines of responsibilities for drainage ; maintenance and construction between the Town and D.O.T.
4. Develop a drainage ordinance.
5. Develop a storm water drainage design manual.

FIGURE B
PHOTOGRAPH INDEX

A. SILTATION, TRASH, & RESTRICTIVE PEDESTRIAN CROSS-OVERS

1. Pedestrian Cross-over in N-S ditch causing trash build-up at Albemarle St.
2. Pedestrian Cross-over in N-S ditch (pipe undersized) (N. of Aycōck St.)
3. Vegetation, trash accumulation at Memorial Dr. & Carolyn Dr.
4. Pedestrian cross-over in N-S ditch with undersized pipe (Pamlico St.)

B. TYPICAL PONDING PROBLEMS DUE TO AREAS WITH SOILS WHICH HAVE POOR VERTICAL DRAINAGE AND/OR NO CONVENTIONAL DRAINAGE OUTLET.

5. Fresh Pond overflowing banks and flooding "Ocean Acres Subdivision". (Date: 4-1-83)
6. Ocean Acres Drive west of Bell Ave. (Date: 2-15-83)
7. "Ocean Acres", Copley Dr. at Richard Klein's residence (Date: 2-15-83)
8. "Ocean Acres", Copley Dr. at Richard Klein's residence (Back yard is adjacent to the Fresh Pond.)
9. Ocean Acres; Sawin Residence on Ocean Acres Dr. (Date: 4-1-83)
10. Ocean Acres; Resident installed a Dike System around house (See Photo #13)
11. Whispering Pines; Quail Lane at Helen Dr. (Date: 2-15-83)
12. Whispering Pines; Quail Lane and Goldie St.
13. "Ocean Acres"; outlet for Dike System (See Photo #10).
14. Septic Tank draining into outfall ditch (Hardin St. & Fourth St.)
15. "Avalon Beach"; Blocked ditch south of Wilson St. (See Photo #18)
16. Fill material in ditch just upstream of Tanya's Ocean outfall.
17. "Avalon Beach"; Ponding north of Charlotte St. (Date: 2-15-83)

18. Fill Material in ditch just upstream of Tanya's Ocean outfall. (See Photo #16)
19. Inlet to existing Ocean outfall at Tanya's Ocean House.
20. Ponding at intersection of Helga & Raymond Ave.
21. Residence on East side of Apache Dr. (Date: 4-11-83)
22. Residence of West side of Indian Dr.
23. Archdale St. West
24. Seminole St. North
25. Suffolk St. at intersection of Newport News.
26. White Court (Cul-de-sac)
27. Durham St. at intersection of Portsmouth St.
28. Arch St. looking East across Susan Dr.

C. TYPICAL PONDING PROBLEMS ALONG RTE. 158 BUSINESS & RTE. 158 BYPASS

29. Flooding 158 Business (outfall buried by Northeast storm; (2-15-83)
30. Flooding 158 Business (outfall buried by Northeast storm.
31. Ponding West of Rte. 158 Business at "Jolly Roger".
32. Flooding on 158 Business in area of Third St. to Fifth St. (Date: 2-15-83)
33. East of Rte. 158 Bypass at "Seagate North".
34. West of Rte. 158 Bypass at South end of Kill Devil Hills (McDonalds).

D. TYPICAL MAJOR DITCH SYSTEM IN KILL DEVIL HILLS

35. Existing North-South Drainage ditch North of Aycock St.
36. Drainage ditch in area of Kill Devil Hills Town Hall Bldg.

E. TYPICAL DRAINAGE RELATED PROBLEMS OTHER THAN PONDING

37. Buried pipe culvert under Rte. 158 Bypass at Durham St.
38. Erosion, silt, & pavement damage at Wilkinson St. & Virginia Dare Rd.

39. Pavement deterioration of Baum St. due to failing pipe joints.
40. Poor planning/utility conflicts with drainage from Kentucky Fried Chicken parking lot.
41. Erosion, broken pavement, pavement deterioration at Third St.
42. Pavement deterioration at Third St. in area of the lake.
43. Pavement deterioration on Wilkinson St, west of Bypass.
44. Pipe culvert damaged during clean-out under Fifth St. west of Bypass.

F. COMMERCIAL DEVELOPMENT ALONG RTE. 158 BYPASS

45. Barnes St. (Nags Head)
46. Barnes St. (Nags Head)
47. Typical drainage into U.S. Rte. 158 Bypass right-of-way.
48. Carolyn Drive (McDonalds)
49. Residential development along Rte. 158 Business on north end of beach.

G. OCEAN OUTFALLS

50. Existing 24" RCP on piles just north of "Seashore Shops".
51. Existing 30" CMP at Baum St. being uncovered by D.O.T.
(2-16-83)
52. Outlet of 30" CMP at Baum St. after opened up by D.O.T.
(2-16-83)
53. Typical ocean outfall plan; bents & layout
54. Typical ocean outfall plan; manhole & flapgates.

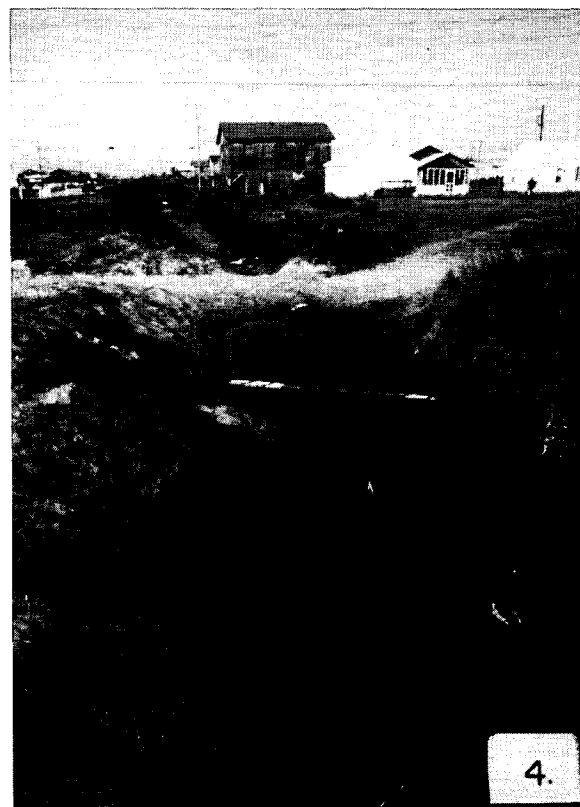
H. TYPICAL METHODS OF IMPROVING AND CONTROLLING DRAINAGE/RUNOFF

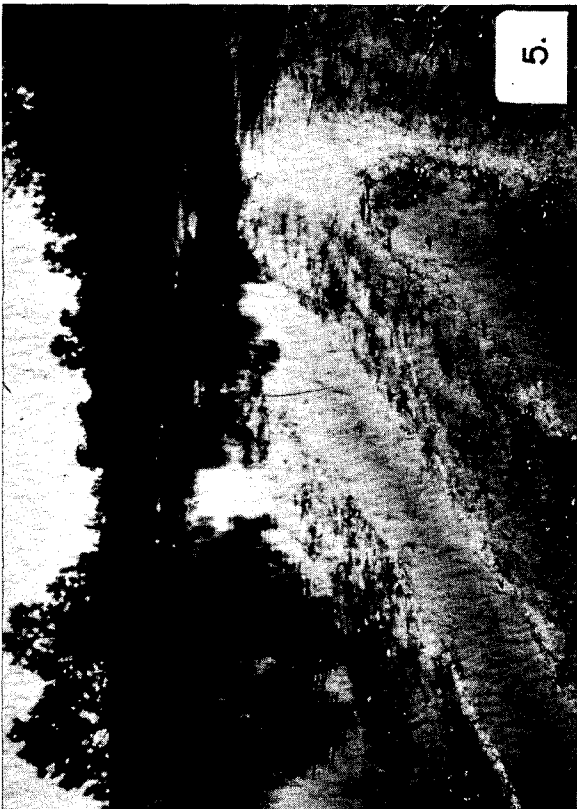
55. Turfstone Paving allowing infiltration at "The Windmill"
56. Grading to infiltration pond/area; Guy C. Lee, Kitty Hawk.
57. Grading to infiltration trench; Nags Head Shopping Center.U./C.
58. Shoulder stabilization with stone; Wrightsville Ave.,
Nags Head.
59. Infiltration trench specifics.

- 60. Slotted drain allows surface water through top as well as through inlet.
- 61. Asphalt paving around pipe culvert outlet reduces erosion & siltation.
- 62. Simple but effective drop structure reduces erosion.
- 63. Sand fencing reduces wind blown sand and erosion.

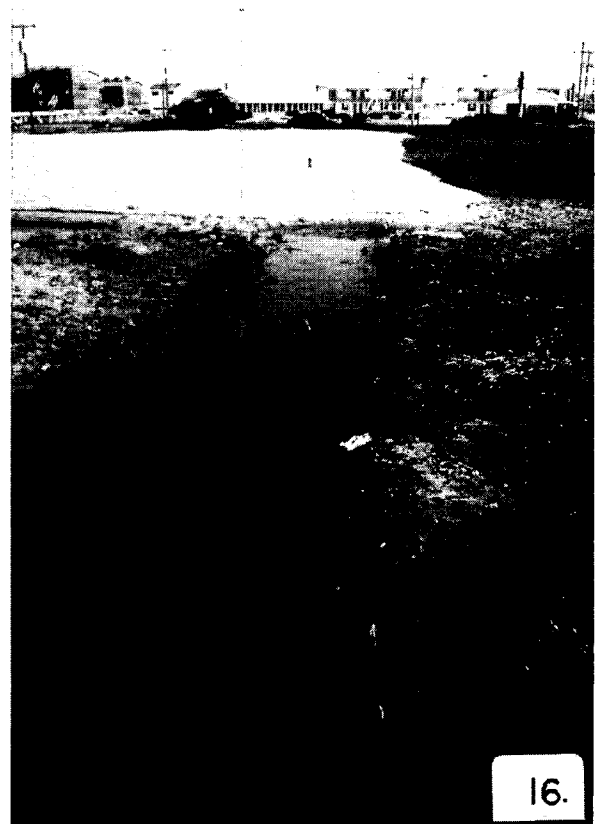
FIGURE C
"PHOTOGRAPHS"

NOTE: Numbers on photographs are referenced to map (Figure A)
in back packet, and Photograph Index (Figure B)







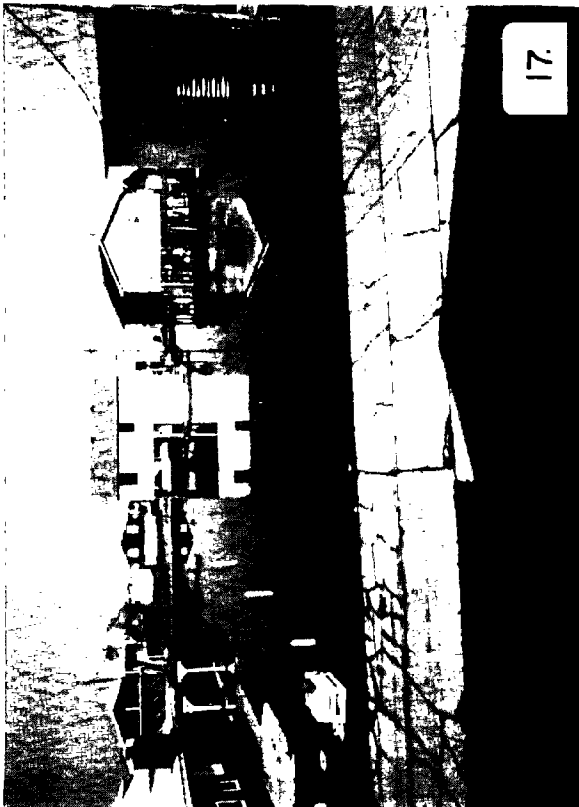




18.



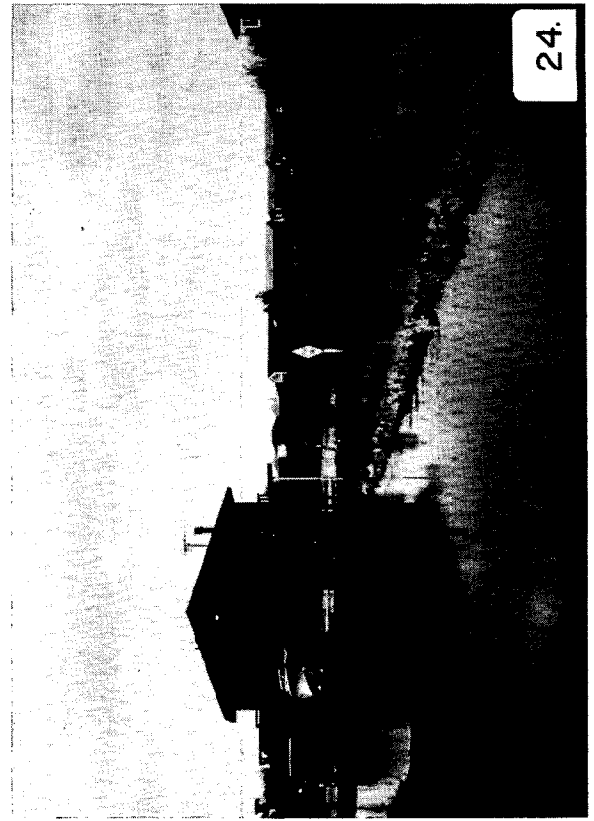
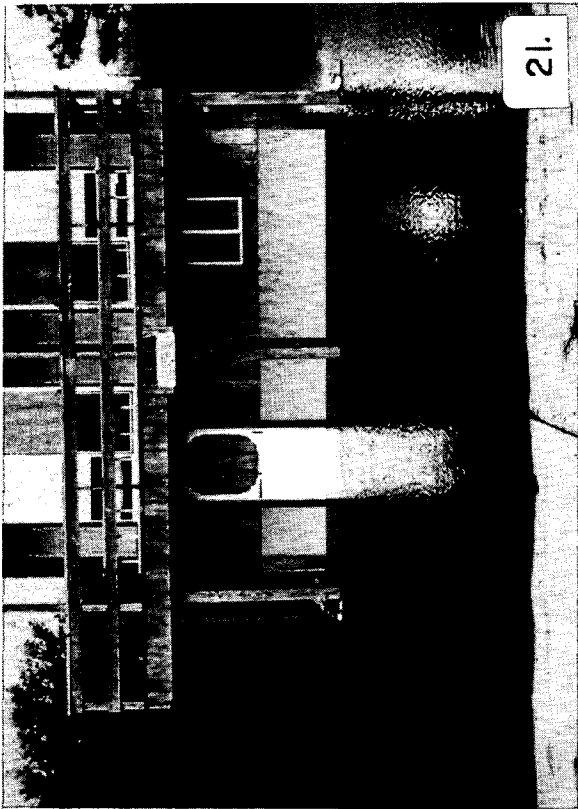
20.



17.



19.



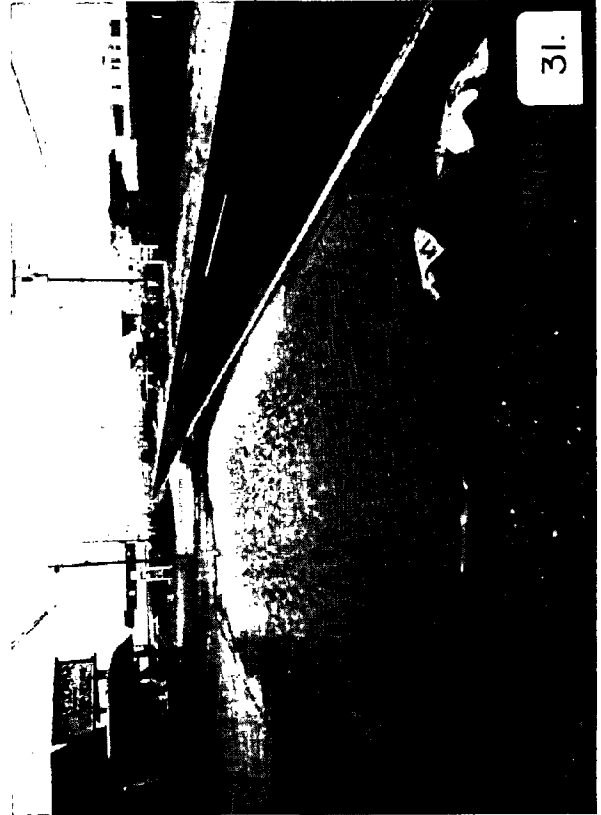




29.



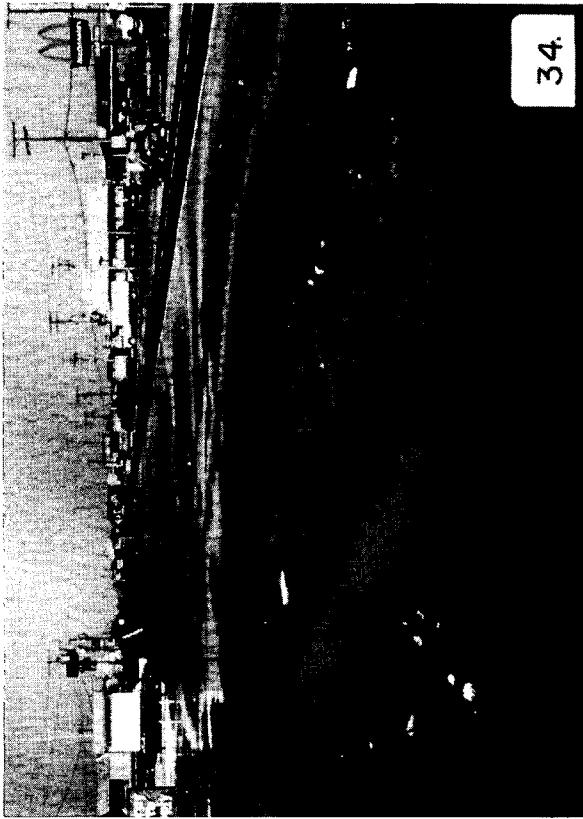
30.



31.



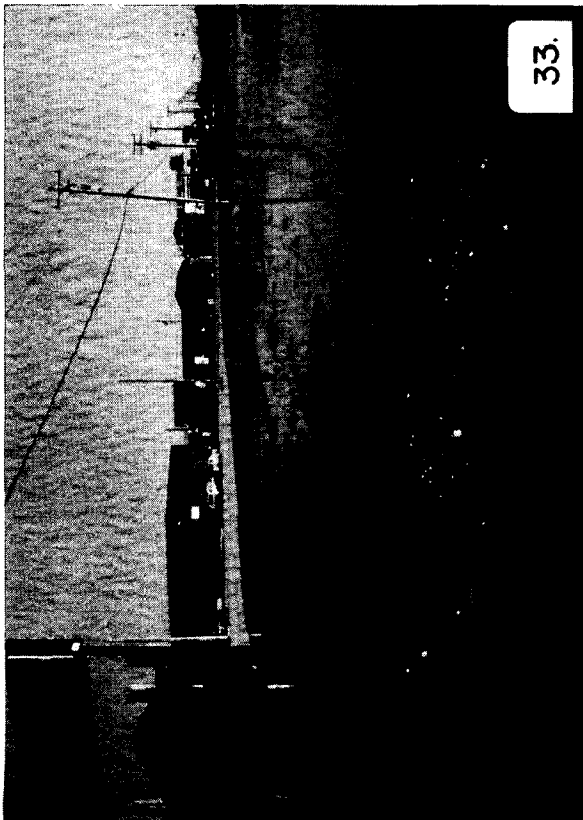
32.



34.



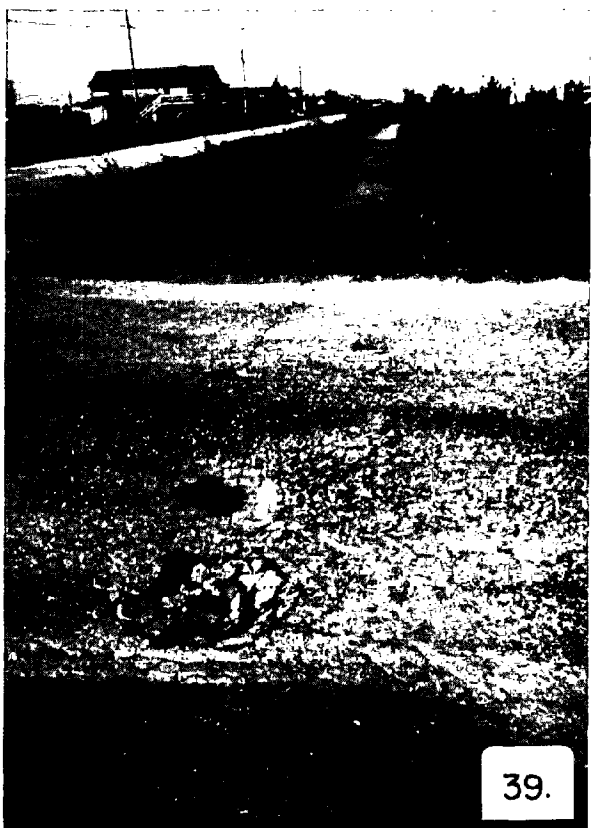
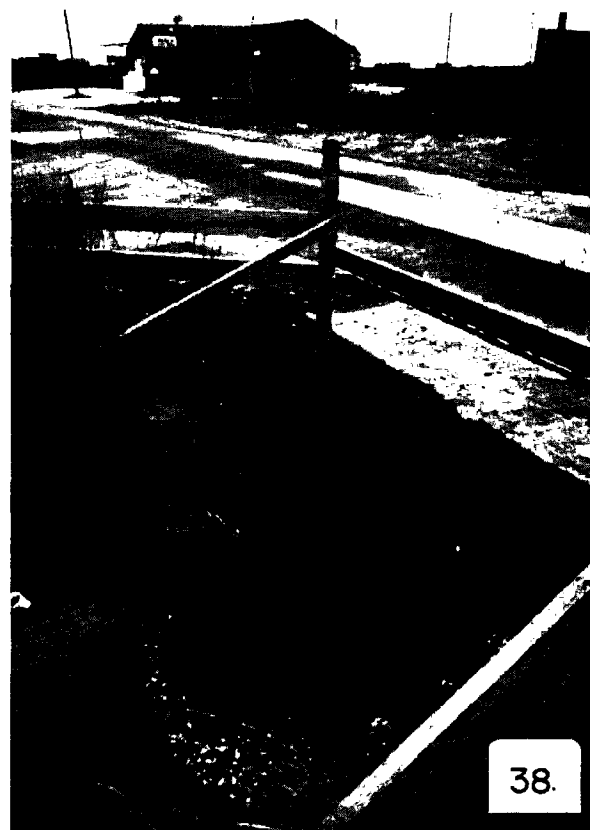
36.

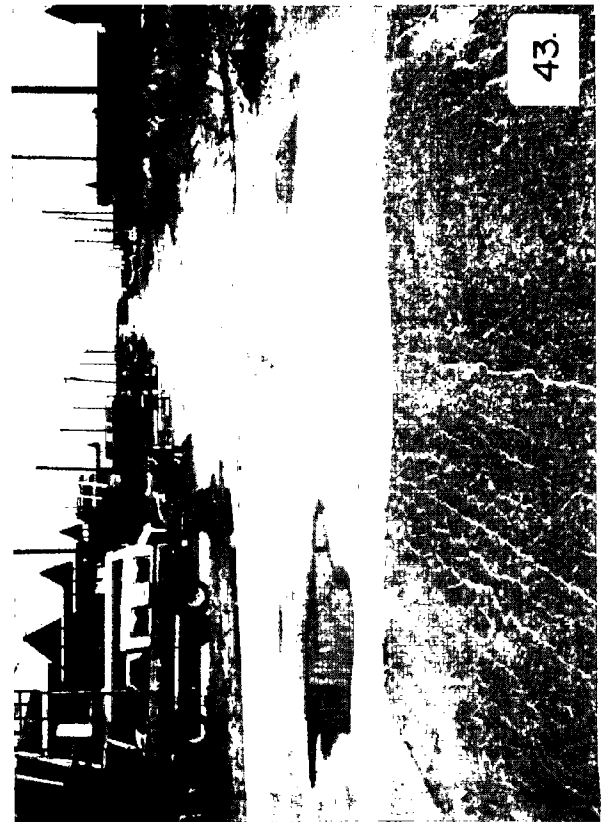
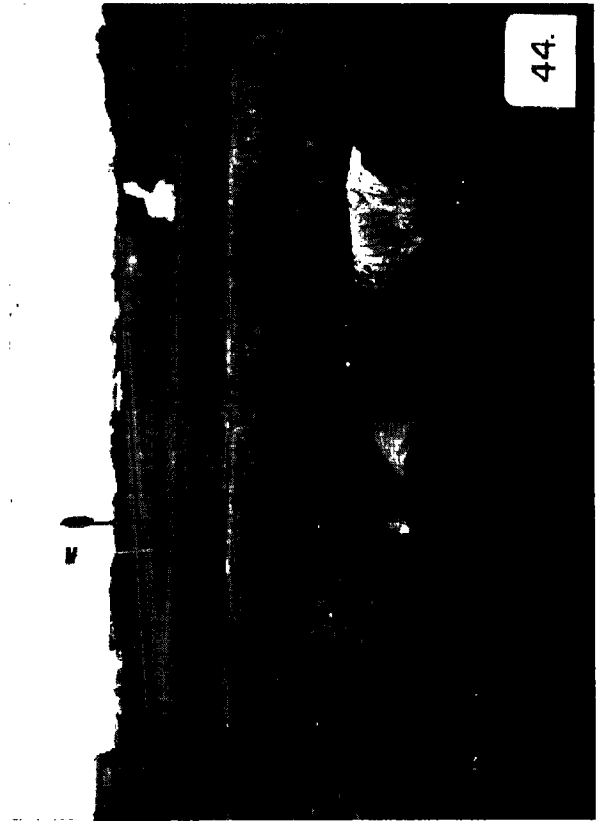


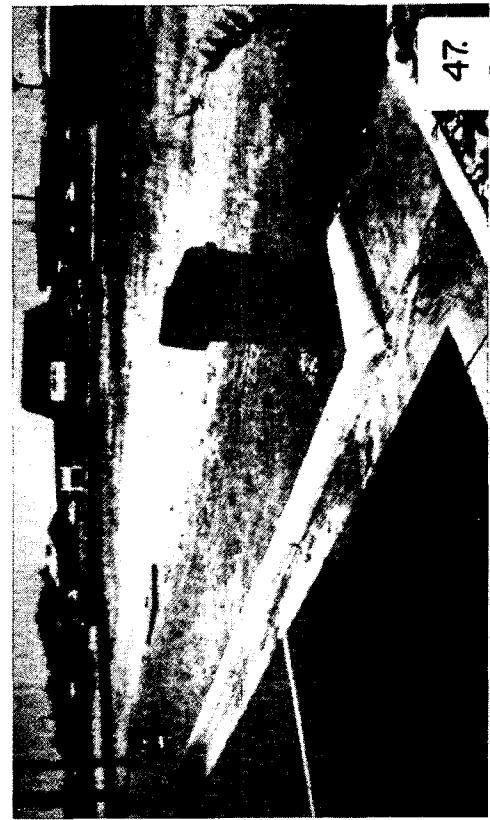
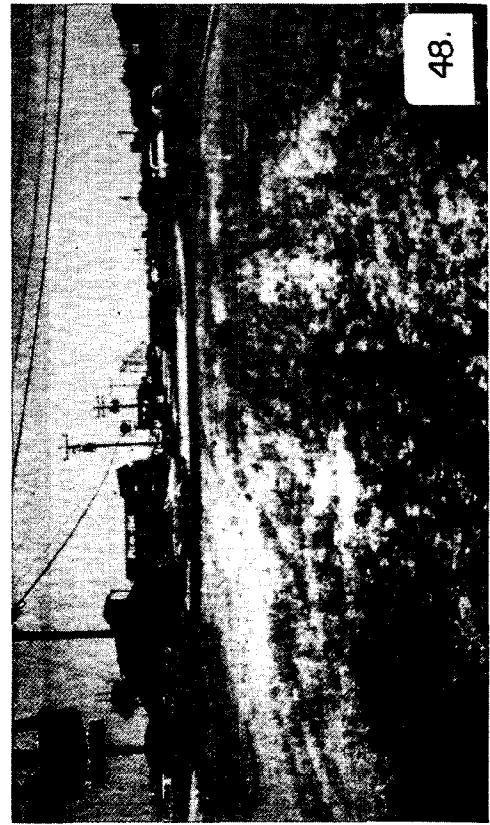
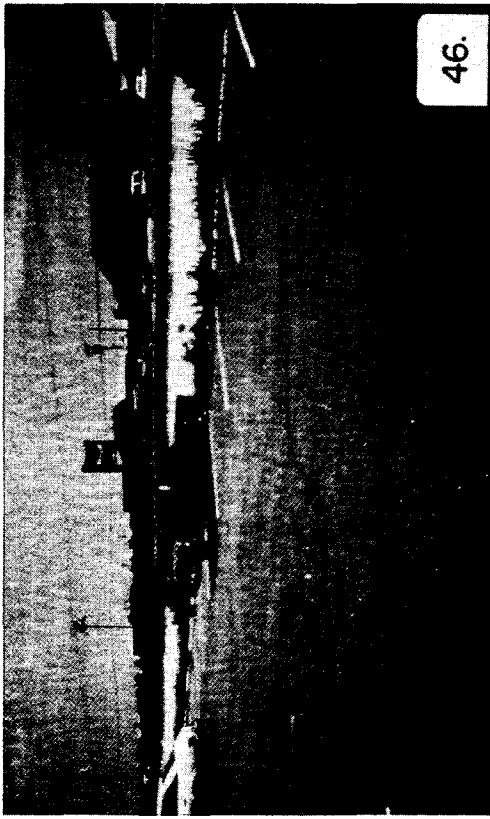
33.

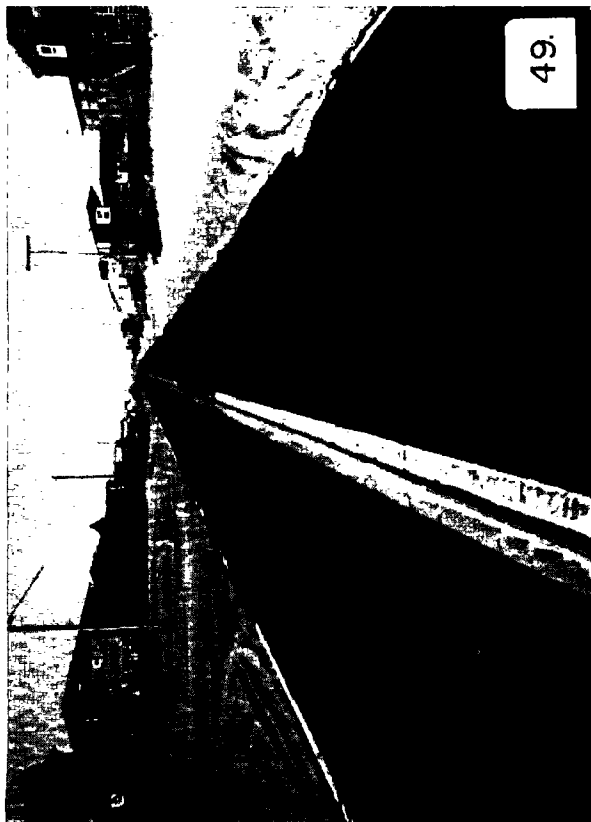


35.

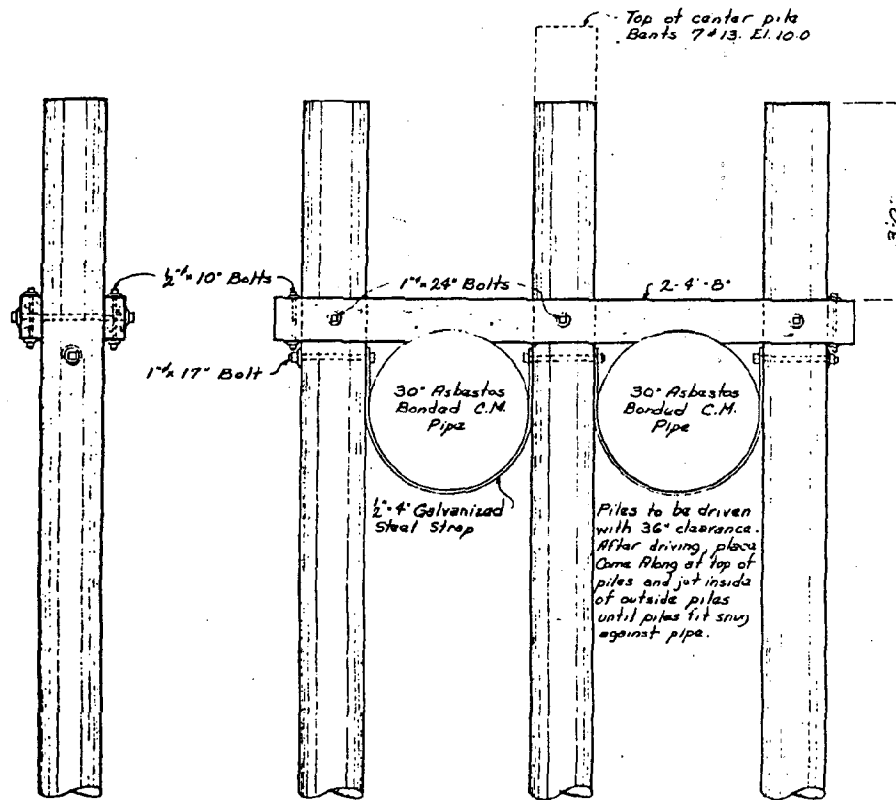
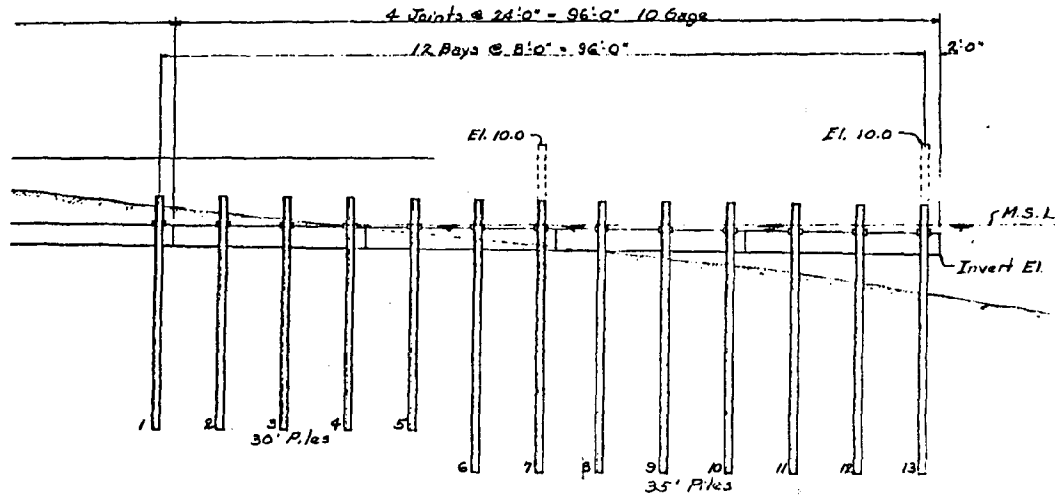








TYPICAL OCEAN OUTFALL

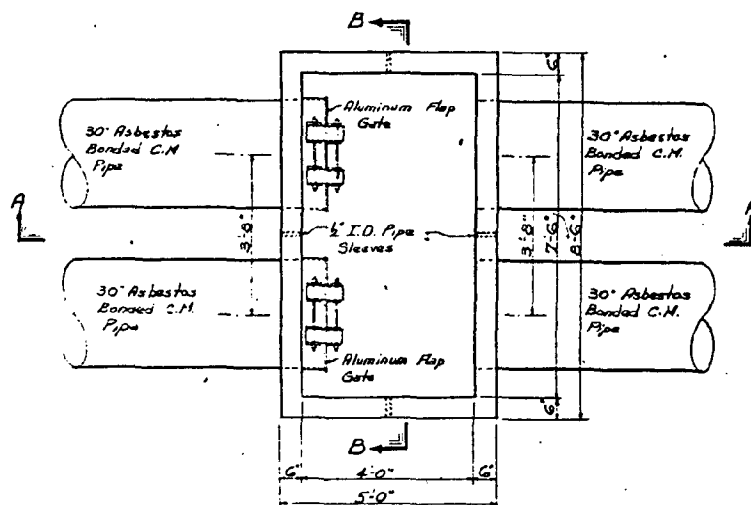


DETAIL OF BENTS

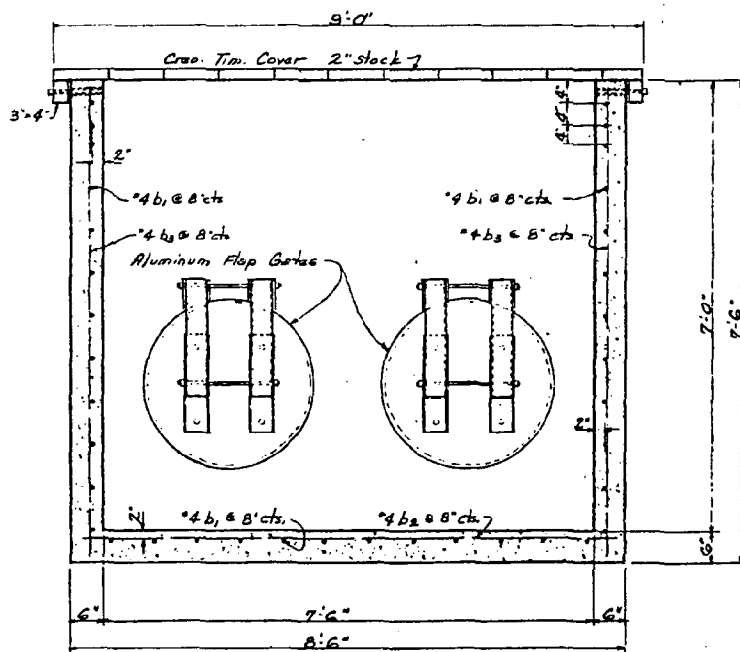
53.

Details taken from Ocean Outfall No. 3 Drawing By Bridge Maintenance Department, N.C. State Highway Commission, Raleigh, N.C., File No. 6728, Date April 1964.

TYPICAL OCEAN OUTFALL



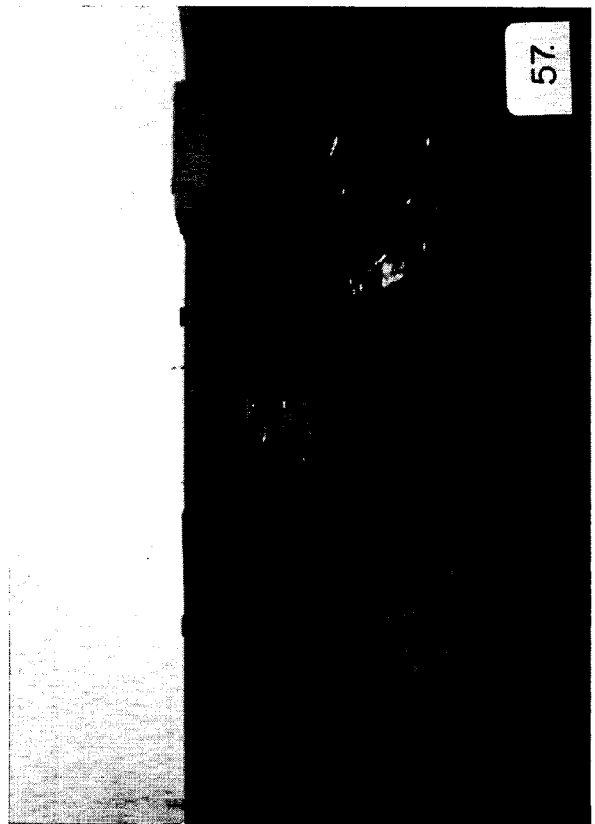
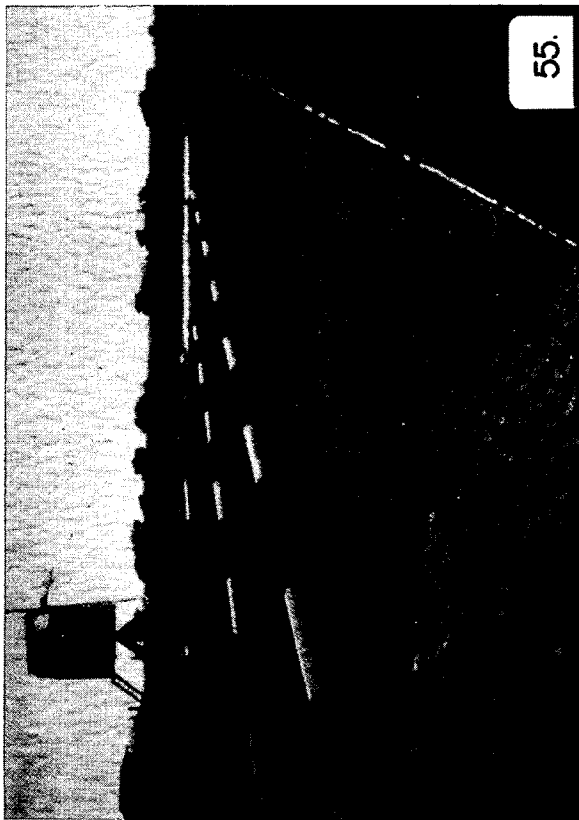
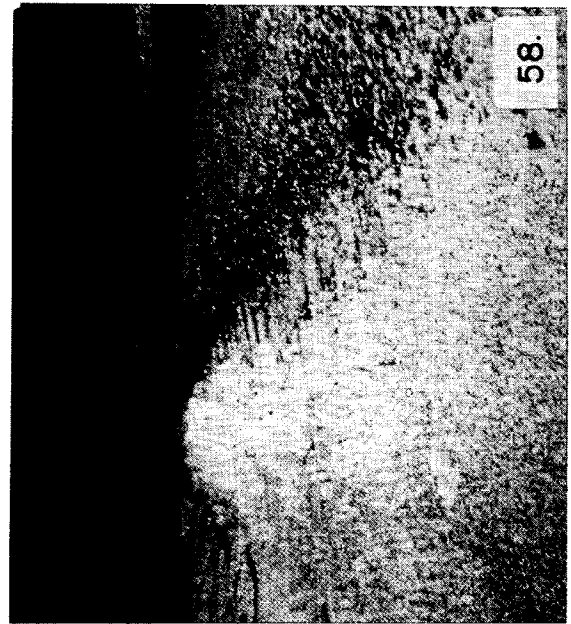
PLAN OF MANHOLE

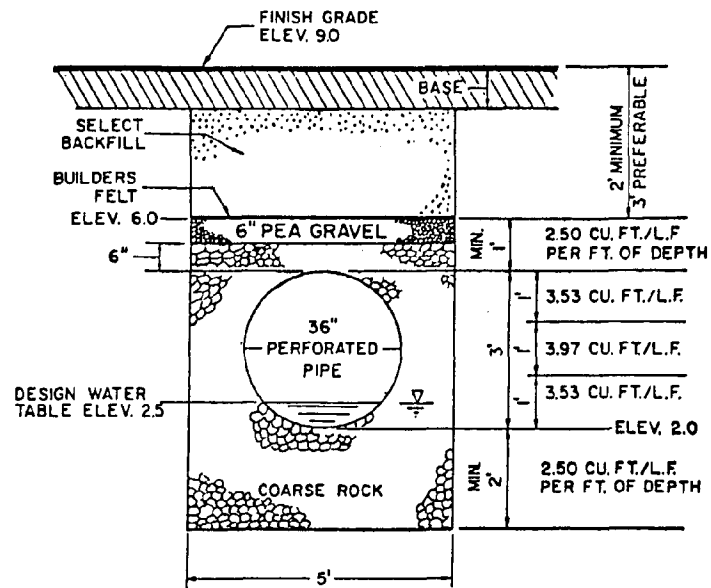


SECTION B-B

54.

Details taken from Ocean Outfall No. 3 Drawing By Bridge Maintenance Department, N.C. State Highway Commission, Raleigh, N.C. File No. 6728, Date April 1964.





NOTE: VOLUMES ARE COMPUTED BASED
ON 50% VOIDS IN ROCK BACKFILL
1 INCH = 25.4 MM
1 FOOT = 0.305 M
1 CU. FT. = 0.028 M³

DETAIL SHOWING VOLUME OF STORAGE
IN INFILTRATION TRENCH (COURTESY
OF BRISTOL, CHILDS & ASSOCIATES,
CORAL GABLES, FLORIDA)



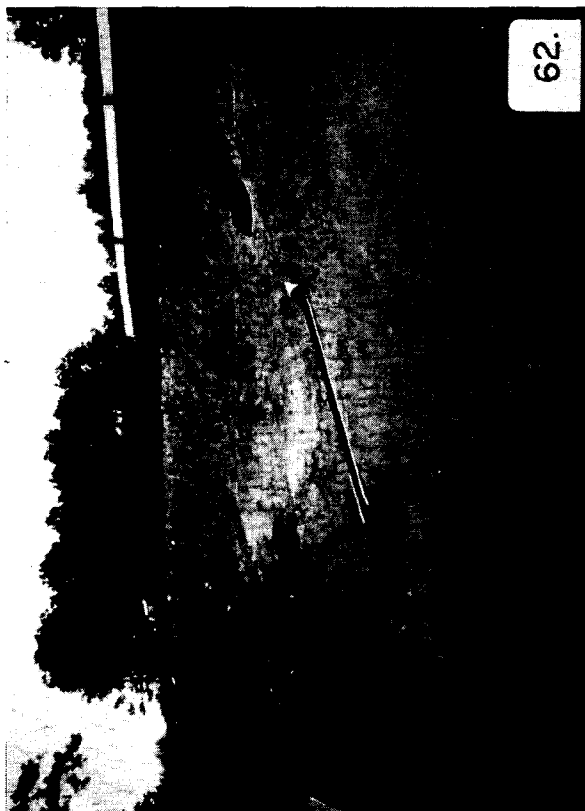
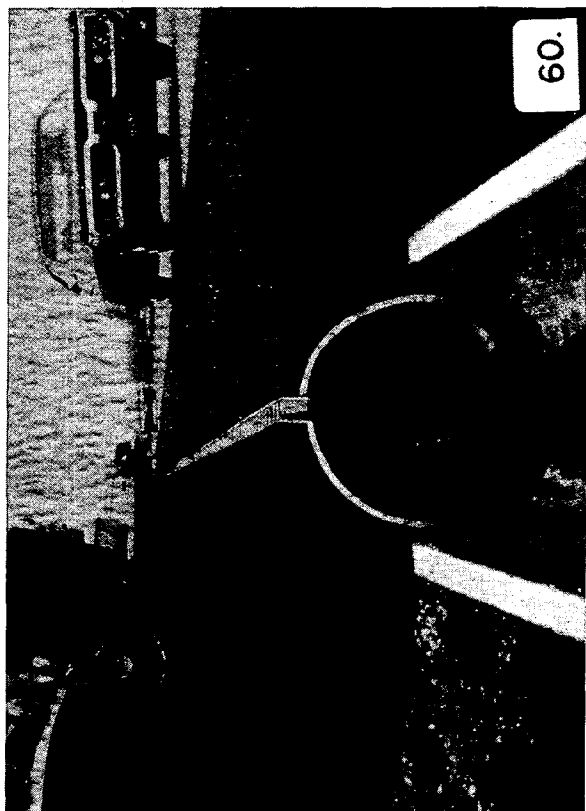


FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-1	1. (Photos. 23, 28, 43)	PONDING IN AREAS OF SOILS WITH POOR VERTICAL DRAINAGE FROM INTERSECTION OF ARCH ST. & SUSAN DR. TO EDEN ST. (PRIORITY NO. 3)	CONSTRUCT 4700'± OF BASE DITCH, (MOST IN SEA-VIEW AVE. R/W DUE TO BEING LOWEST AREA AND ALSO UNIMPROVED), STREET CROSSING CULVERTS, MINOR ROADSIDE SWALES TO REACH BASE DITCH, STREET PATCHING, SEEDING & EROSION CONTROL, AND ENGINEERING & CONTINGENCIES= \$7.50 x 4700'±= \$32,250
	2. (Photo 20)	PONDING AT STREET INTERSECTION OF HELGA ST. & RAYMOND AVE.	INSTALL CULVERTS UNDER STREET TO DRAIN INTO A PROPOSED ROADSIDE SWALE TO THE NORTH-SOUTH (N.-S.) DITCH WEST OF PONDING.
	3.	SILTATION OF NORTH-SOUTH (N.-S.) AT THE N.-E. CORNER OF "SEAGATE NORTH" BLDG.	CLEAN-OUT TO CORRECT ELEVATION; IN THIS AREA THE N.-S. DITCH NEEDS TO HAVE VEGETATION & TRASH REMOVED FROM ARCH ST. SOUTH TO WILKINSON ST. CULVERT.
	4. (Photo 33)	PONDING ON PARKING LOT & 158 BYPASS R/W AT SEAGATE NORTH SHOPPING CENTER.	USE SWALES AND/OR CULVERTS AT ENTRANCES TO BYPASS, DITCH TO NORTH END OF PARKING LOT, THEN DITCH EAST TO THE N.-S. DITCH. (SOILS IN BETWEEN ENTRANCES TO BYPASS DO NOT DRAIN WELL VERTICALLY.)
	5.	PONDING AT INTERSECTION OF WILKINSON ST. & 158 BUSINESS.	INSTALL PIPE CULVERT AT INTERSECTION, DRAIN TO N.-S. DITCH WITH A DITCH ON THE SIDE OF WILKINSON ST. THAT HAS THE LEAST UTILITY CONFLICTS.

(D-1)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-1	6. (Photo 38)	EROSION, SILTATION, & PAVEMENT DAMAGE AT HEADWALL ON WILKINSON ST. (N.-S. DITCH).	CONCENTRATE STREET RUN-OFF TO ONE POINT OF RELEASE WITH ASPHALT CURBING, THEN USE EITHER A CONCRETE CHUTE TO INVERT OF DITCH (OR SOME TYPE OF SOIL REINFORCEMENT MATTING).
	7.	INLET & OUTLET ENDS OF CORRUGATED METAL PIPE CRUSHED.	REPAIR OR REPLACE; CRUSHED ENDS RESTRICT MAJORITY OF FLOW AT THIS POINT.
	8. (Photo 2)	PEDESTRIAN CROSSING JUST NORTH OF AYCOCK ST.; SMALL CULVERT RESTRICTS FLOW, CAUSES TRASH BUILD-UP AT INLET END OF PIPE.	EITHER REMOVE FILL AND SMALL CULVERT, OR INSTALL PROPER SIZE CULVERT BASED ON DOWN-STREAM SIZE. (USING WOODEN BRIDGES WOULD NEED LESS MAINTENANCE & WOULD NOT RESTRICT DRAINAGE.)
	9.	PONDING AT INTERSECTION OF AYCOCK ST. & 158 BUSINESS.	INSTALL A PIPE CULVERT UNDER AYCOCK ST., AND DITCH TO THE N.-S. DITCH ON THE SIDE OF AYCOCK ST. WHICH HAS THE LEAST UTILITY CONFLICTS.
	10.	PONDING EAST OF BYPASS IN LOW, MARSHY AREA BETWEEN ARCHDALE ST. & AYCOCK ST. (THIS AREA'S SOILS HAVE POOR VERTICAL DRAINAGE.)	DITCH EAST TO THE N.-S. DITCH.
	11.	PONDING ON EDEN ST. BETWEEN 158 BYPASS AND BUSINESS RT. 158.	FILL & GRADE STREET WITH A CROWN; SWALES ALONG EDGE OF SHOULDER TO CARRY REMAINDER OF PONDING TO THE N.-S. DITCH.

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-1	12. 13. (Photos 15, 17)	<p>PONDING EAST OF 158 BUSINESS IN AREA OF "K.D.H. MANOR" MOTEL.</p> <p>"AVALON BEACH" AREA; RTE. 158 BYPASS TO 158 BUSINESS FROM DURHAM ST. TO BICKETT ST. OUTFALL DITCH. PONDING ON STREETS & YARDS DUE TO NO DRAINAGE SYSTEM IN SOME AREAS AND WHERE A SYSTEM EXISTS IT HAS NOT BEEN PROPERLY MAINTAINED. MAJORITY OF AREA HAS SOILS THAT DRAIN POORLY VERTICALLY. ALSO, SEWAGE DISPOSAL IS BY INDIVIDUAL SEPTIC TANKS NECESSITATING A WORKING SURFACE WATER DRAINAGE SYSTEM. (PRIORITY NO. 2)</p>	<p>THERE IS NO CLOSE, CONVENIENT OUTLET FOR THIS PONDING. CONSIDER USING INFILTRATION TRENCH AND/OR A PERMEABLE SURFACE WHERE WATER PONDS, SUCH AS "TURFSTONE".</p> <p>AS OF APRIL, 1983, A DETAILED DRAINAGE PLAN IS BEING DONE WHICH WILL BASICALLY ACCOMPLISH THE FOLLOWING THINGS: PROVIDE MAINTENANCE ON THE EXISTING DITCHES & PIPES CHECKING THE NEED FOR REPAIR AND/OR REPLACEMENT. EXTEND THE EXISTING SYSTEM SOUTH TO CHARLOTTE ST. WITH PIPE, AND IMPROVE THAT DRAINAGE ALONGSIDE THE STREETS BY USING A COMBINATION OF ROADSIDE SWALES, GRADED ENTRANCES DRIVES, AND POSSIBLY SOME ENTRANCE CULVERTS. (SOME MINOR FILLING IN SMALL, LOW AREAS MAY BE MORE COST EFFECTIVE THAN SWALES & CULVERTS.)</p>
S-2	14.	<p>PONDING FROM HAYMAN BLVD. TO WILKINSON ST. AND FROM LEE AVE. WEST TO BAYVIEW DRIVE. (PRIORITY No. 11)</p> <p>(D-3)</p>	<p>ROADSIDE DITCHES THROUGH "WET" AREAS, ENTRANCES CUTS & CULVERTS, ASPHALT PATCHING, SEEDING & EROSION CONTROL, ENGINEERING & CONTINGENCIES = \$12,528.</p>

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-3	15. (Photo 25)	PONDING ON SUFFOLK ST. FROM NORFOLK ST. TO SMITHFIELD ST. (PRIORITY NO. 12)	ROADSIDE SWALES TO CROSS PIPES UNDER NEWPORT NEWS & SUFFOLK ST., CROSS PIPES UNDER AVALON DR. & KITTY HAWK DR., CONCRETE DRIVE CUTS, CULVERTS OR GRADED SWALES FOR DRIVES, SEEDING & EROSION CONTROL & ENGINEERING AND CONTINGENCIES = \$12,318.
S-4	16.	PONDING ON SUFFOLK ST. FROM YORK-TOWN ST. TO PORTSMOUTH ST. (SOILS IN THIS AREA HAVE POOR VERTICAL DRAINAGE). (PRIORITY NO. 10)	LOWER EXIST. DITCH ALONG REAR PROPERTY LINES EAST TO YORKTOWN ST., INSTALL CROSS-DRAIN AT SUFFOLK ST. & PORTSMOUTH ST. INTERSECTION, CONSTRUCT ROADSIDE SWALES WITH EITHER GRADED CONC. ENTRANCES OR CULVERTS, SEEDING & EROSION CONTROL, ENGINEERING & CONTINGENCIES = \$17,244.
S-5	17.	PONDING DOCK ST. & PORTSMOUTH ST. INTERSECTION. (PRIORITY NO. 13)	ROADSIDE DITCH ALONG DOCK ST., CROSS-DRAINS AT PORTSMOUTH ST., EDENTON & BAY DRIVE, ASPHALT PATCHING ON STREETS, SEEDING & EROSION CONTROL, ENGINEERING AND CONTINGENCIES = \$7,956.
S-6	18. (Photo 27)	PONDING AT INTERSECTION OF DURHAM ST. FROM PORTSMOUTH TO EDENTON ST. (THIS AREAS SOILS HAVE POOR VERTICAL DRAINAGE) (PRIORITY NO. 4)	LOWER THE EXISTING CULVERT UNDER BAY DRIVE AND DITCH FROM SOUND EAST TO HAMPTON ST. (DITCH WOULD NEED TO BE PIPED FOR 100' ON SOUND SIDE OF BAY DR. DUE TO A NEW HOME ENCRORCHING ON EXIST. DITCH.) INSTALL CROSS-DRAINS AT INTERSECTIONS OF DURHAM & EDENTON, FIFTH ST. & LISA COURT, AND DRAIN TO THESE WITH ROADSIDE SWALES. MISC. ENTRANCE DRIVES WOULD NEED CULVERTS OR SWALES ON SURFACE TO REACH CROSS-DRAINS. ALL DISTURBED AREA TO BE SEEDED & EROSION CONTROLLED PLUS ENGINEERING AND CONTINGENCIES = \$16,530. (D-4)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-7	19. (Photos 21 & 22)	PONDING SEMINOLE ST. WEST TO BAY DRIVE FROM CROATAN DR. TO INDIAN DR. (PRIORITY NO. 7)	CONSTRUCT BASE DITCH FROM SEMINOLE ST. TO SOUND, ROADSIDE SWALES FEEDING BASE DITCH (ENTRANCE CUTS WITH CULVERTS), CROSS-PIPES AT STREET CROSSINGS, ASPHALT PATCHING, SEEDING AND EROSION CONTROL, AND ENGINEERING & CONTINGENCIES = \$40,080.
S-8	20. (Photo 37)	PONDING AT INTERSECTION OF DURHAM ST. & 158 BYPASS.	OPEN UP EXIST. CULVERT UNDER 158 BYPASS ON NORTH SIDE OF DURHAM ST.,
S-8	21.	PONDING BETWEEN DURHAM & FIFTH ST. FROM BYPASS TO SMITHFIELD ST.	CONSTRUCT A DITCH ALONG REAR PROPERTY LINES BETWEEN DURHAM & FIFTH ST., USE A CROSS-DRAIN AT DURHAM & NEWPORT NEWS INTERSECTION AND ROADSIDE SWALES TO GET DRAINAGE INTO BASE DITCH. INSTALL A CULVERT UNDER DURHAM ST. ON WEST SIDE OF BYPASS (OR CONC. SWALE ACROSS DURHAM), DITCH TO TIE-INTO EXIST. DITCH JUST SOUTH OF DURHAM ST., LOWER EXIST. DOUBLE LINE CULVERT UNDER FIFTH ST. (ONE ALREADY DAMAGED), AND LOWER DITCH TO 4th ST., SEEDING & EROSION CONTROL AND ENGINEERING & CONTINGENCIES = \$10,544.
	22. (Photo 44)	1-LINE OF EXIST. DBL. LINE OF 18" CMP IS DAMAGED (BOTH PIPES NEED TO BE LOWERED FOR PROBLEMS #20 & #21).	REPAIR OR REPLACE.
		(D-5)	

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-8	23. (Photo 24)	PONDING ON CLAMSHELL DR. FROM SEMINOLE ST. TO WYANDOTTE ST. (THIS AREA HAS SOILS WHICH HAVE POOR VERTICAL DRAINAGE.) (PRIORITY NO. 5)	CONSTRUCT A NEW DITCH FROM CREEK ST. TO THE EXIST. RTE. 158 BYPASS DITCH, CROSS-DRAIN AT SEMINOLE & CLAMSHELL, ROADSIDE SWALES WITH CULVERTS UNDER ENTRANCES, PAVEMENT PATCHING, SEEDING & EROSION CONTROL, AND ENGINEERING & CONTINGENCIES = \$9,600.
	24. (Photos 31, 32, 41, & 42)	PONDING ON RTE. 158 BUSINESS FROM THIRD ST. TO FIFTH ST. WHEN OCEAN TOPS DUNELINE EAST OF BUSINESS RTE. 158; WATER PONDS ON PAVED AREAS ALONG BUSINESS AFTER HEAVY RAINS.	INSTALL A CATCH BASIN JUST SOUTH OF THE "JOLLY ROGER", WITH AN OUTLET PIPE DRAINING TO THE POND WEST OF BUSINESS 158. USE PAVED ROADSIDE SWALES (GRADED) TO DRAIN PONDED SURFACE WATER TO NEW CATCH BASIN. ALSO, (#25) TO REDUCE PAVEMENT DAMAGE ON THIRD ST. & DRAINAGE BACK-UP REPLACE EXIST. 12" PIPE WITH A NEW 18". THEN, (#26) LOWER POND OVERFLOW TO MATCH THE ELEVATIONS OF THE EXIST. BYPASS CROSS-DRAIN.
	25.	SMALL, BLOCKED 12" UNDER THIRD ST. RESTRICTS DRAINAGE TO SOUND AFTER A MAJOR N.-E. STORM (OCEAN OVER WASH).	
	26.	EXIST. 18" POND OVERFLOW PIPE IS HIGH AND REDUCES THE AMOUNT OF STORAGE VOLUME THE PONDS COULD HANDLE IF LOWERED.	
		(D-6)	

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-8	27.	PONDING IN HARBOUR DR. & LANDING DR. AREA. (PRIORITY NO. 8)	CONSTRUCT A BASE DITCH FROM EXIST. BYPASS CROSS-DRAIN AT ASHEVILLE DR. TO LANDING DR. & HARBOUR DR. INTERSECTION, CROSS-DRAINS AT ST. CROSSINGS, ROADSIDE SWALES WITH EITHER CULVERTS UNDER ENTRANCES OR GRADED TOP SURFACES, PAVEMENT PATCHING, SEEDING & EROSION CONTROL, ENGINEERING & CONTINGENCIES = \$19,290.
	28.	VEGETATION IN BYPASS WEST DITCH IMPEDES DRAINAGE FLOW TO SOUND.	PROVIDE REGULAR SCHEDULED MAINTENANCE.
	29.	PONDING EAST OF BUSINESS 158 IN FRONT OF THE "LAMPLIGHTER".	INSTALL CATCH BASIN ON EAST SIDE OF BUSINESS 158 CROSS-DRAIN UNDER BUSINESS 158, DITCH TO THE EXIST. N.-S. DITCH.
	30.	PONDING ON SUTTON, PINEHURST, & ROANOKE AVE.	ONE EACH STREET, CONSTRUCT A SWALE ON SIDE OF STREET WITH NO UTILITIES, GRADING ENTRANCES OR USING CULVERTS INCL. ONE CROSS-DRAIN UNDER MEMORIAL AVE. DRAINING TO N.-S. DITCH.
	31.	PONDING ON FUTURE SITE OF "ZIP MART".	INSTALL CROSS-DRAIN UNDER OCEAN BAY BLVD. TO DRAIN TO EXIST. BYPASS WEST DITCH.
S-8			

(D-7)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-8	32. (Photo 1, 4)	PEDESTRIAN CROSSINGS AT ALBEMARLE ST. & PAMLICO ST. RESTRICT DRAINAGE IN N.-S. DITCH AND CAUSES TRASH BUILD-UP AT INLET OF SMALL PIPES.	EITHER REMOVE FILL AND SMALL CULVERT, OR INSTALL PROPER SIZE CULVERT BASED ON DOWN-STREAM SIZE. (USING WOODEN BRIDGES WOULD NEED LESS MAINTENANCE & WOULD NOT RESTRICT DRAINAGE.)
	33.	PONDING EAST & WEST OF BUSINESS RTE. 158 IN VICINITY OF "THE TRADING POST".	INSTALL CATCH BASIN ON EAST SIDE OF BUSINESS, CROSS-DRAIN TO WEST SIDE, DITCH ALONG 158 BUSINESS TO OREGON AVE., THEN TO N.-S. DITCH ALONG OREGON AVE. (SOME PONDING COULD BE ELIMATED BY FILLING, BUT NOT ALL.)
	34.	PONDING EAST OF PIRATES LOOP & SOUTH OF LANDING DRIVE.	SWALE TO EXIST. DRAINAGE DITCH CROSSING LANDING DRIVE (ON SOUTH SIDE).
	35. (Photo 26)	PONDING EAST & WEST OF MONUMENT LANE AT WHITE CULDESAC AREA. (SOILS IN THIS AREA HAVE POOR VERTICAL DRAINAGE.) (PRIORITY NO. 6)	INSTALL A CROSS-DRAIN AT LOW POINT OF MONUMENT LANE, THEN DITCH SOUTH TO CANAL DRIVE WITH CROSS-DRAIN THERE, ACROSS PROPERTY LINES TO LANDING DR. TO LARGE CANAL. (ELEVATION DIFFERENCE AT CANAL MAY NECESSITATE A DROP STRUCTURE.)
		(D-8)	

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
S-8	36.	PONDING ALONG LANDING DRIVE FROM SEALOFT CT. TO SCHOONER CT.	USING CROSS-DRAIN AT HARPOON CT., DRAIN RUN-OFF TO NORTH SIDE OF LANDING DR. AND USING CULVERTS UNDER STREET APPROACHES & A SWALE DRAIN TO THE CANAL N.-E. OF SEAGULL CT.
	37.	PONDING ON EAST SIDE OF CANAL DRIVE SOUTH OF FIRST FLIGHT LANE.	USE CROSS-DRAIN UNDER FROELICH CT. & FIRST FLIGHT LANE TO DRAIN INTO EXIST. DITCH ON NORTH SIDE OF FIRST FLIGHT LANE. (SOME EXIST. DRIVES WILL NEED CUTTING, CULVERTS, & PATCHING.)
	38.	PONDING NORTH & SOUTH OF DOGWOOD LANE INTERSECTION WITH	USE ROADSIDE SWALES WITH CULVERTS UNDER DOGWOOD LANE AND TO DRAIN PONDING WATER TO CANAL.
	39. (Photo 62)	EROSION AT EXIST. OUTLET (83" x 57" CMP) ON FIRST FLIGHT LANE.	USE CONC. DRAINAGE CHUTE FROM LOW POINT IN PAVEMENT TO PREVENT EROSION FROM STREET RUN-OFF. ALSO, ON EACH SIDE OF FIRST FLIGHT LANE ESTABLISH VEGETATION ON SLOPES. (TOPSOIL WILL NEED TO BE HAULED IN, AS EXIST. SAND WILL NOT SUPPORT VEGETATION.)
0-1	40.	PONDING IN VICINITY OF KILL DEVIL HILLS POST OFFICE. (D-9)	DRAIN SOUTH ALONG NORFOLK AVE. R/W TO EXIST. DITCH SOUTH OF GODDARD AVE.

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
0-1	41.	PONDING ON CLARK ST. & CORRIGAN ST (CLAY STREETS) AND ALSO INTERSECTION OF LANDING STRIP RD. & 158 BYPASS.	DRAIN ALL 3 AREAS EAST TO BYPASS USING SWALES & CULVERTS, DIG A NEW BYPASS DITCH NORTH TO THE EXIST. DITCH SOUTH OF GODDARD ST., INSTALLING CROSS-DRAINS AT STREET APPROACHES.
	42.	PONDING AT CORRIGAN ST. & WRIGHTSVILLE AVE. INTERSECTION (CLAY STREETS).	ROADSIDE SWALES TO NEW CROSS-DRAIN AT INTERSECTION, DITCH EAST ALONG CORRIGAN ST. TO EXIST. N.-S. DITCH.
	43.	PONDING ON CLARK ST., BETWEEN WRIGHTSVILLE AVE. & BUSINESS RTE. 158.	ROADSIDE SWALE TO N.-S. DITCH.
	44.	PONDING EAST OF BUSINESS RTE. 158 IN FRONT OF "THE FIRST FLIGHT INN".	MODIFY EXIST. JUNCTION BOX AT OCEAN OUTFALL TO RECEIVE A GRADED PAVED SWALE FROM FIRST FLIGHT INN. (STUB SMALL PIPE OUT OF JUNCTION BOX.)
	45. (Photos 51, & 52)	EXIST. OCEAN OUTFALL, (SINGLE LINE OF 30" CMP) IS NOT ON PILING SUPPORTS & DOES NOT EXTEND TO OCEAN AS IT SHOULD.	CONSIDER UPGRADING THIS OCEAN OUTFALL BY EXTENDING IT INTO OCEAN ON PILINGS, ADDING A FLAPGATE DEVICE, AND VERIFY THAT THIS OUTFALL HAS AN EXIST. EASEMENT. IF EASEMENT DOES NOT EXIST, MAKE ARRANGEMENTS TO SECURE ONE.
			(D-10)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
0-2	46. (Photos 5,6, 7, & 8)	<p>"OCEAN ACRES" = PONDING IN YARDS AND IN SOME CASES IN HOMES, ALSO PONDING ON STREETS CAUSING TRAFFIC PROBLEMS AS WELL AS ACCELERATING STREET DETERIORATION. (LOW AREAS AT ELEVATION 10±, ARE SURROUNDED BY HIGHER GROUND WITH NO OUTLET WHEN SOILS BECOME SATURATED.) (PRIORITY NO. 1)</p>	<p>AS OF APRIL 1983, A DETAILED DRAINAGE PLAN IS BEING DONE WHICH WILL BASICALLY ACCOMPLISH THE FOLLOWING THINGS:</p> <p>BEGIN AN 15" STORM SEWER SOUTH OF OCEAN ACRES DR., BETWEEN COPLEY DR. & JONES CT., CONTINUE NORTH THROUGH SUBDIVISION ALONG PROPERTY LINES (WITH EASEMENTS) ACROSS BURNS DR. & TIE INTO SYSTEM WHICH TRAVERSES "WHISPERING PINES" SUBDIVISION. THIS MAIN STORM SEWER LINE WILL BECOME THE MAJOR OUTLET FOR STREET & YARD DRAINAGE. RUN-OFF WILL BE DRAINED TO THE "MAIN OUTLET" BY DITCHES ALONGSIDE STREETS WITH CULVERTS PLACED AT DRIVEWAYS & STREET CROSSINGS. A PORTION OF "OCEAN ACRES" WILL BE DRAINED TO THE D.O.T. PROPOSED DRAINAGE SYSTEM ALONG RTE. 158 BYPASS; SEE #54. FUTURE INVESTIGATION WILL CONTINUE ON POSSIBLE POND OVERFLOW DRAINAGE SYSTEM TO HELP REGULATE POND ELEVATION. NO COST ESTIMATE SINCE DETAIL PLAN IN PROGRESS AS OUTLINED ABOVE.</p>

(D-11)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
0-2	47. (Photos 11, & 12)	"WHISPERING PINES" SUBDIVISION; PONDING ON MOSTLY UNDEVELOPED LOTS & STREETS. (NOTE: LOW AREAS AT ELEVATION 10± ARE SURROUNDED BY HIGHER GROUND WITH NO OUTLET WHEN SOILS BECOME SATURATED.)	PIPE SYSTEM THROUGH SUBDIVISION (SOUTH UPSTREAM INLET JOINS "OCEAN ACRES" SYSTEM DISCUSSED IN # 46), TO NORTH LIMITS OF WHISPERING PINES SUBDIVISION, THEN A NEW FLAT-BOTTOM DITCH ALONG THE WEST R/W OF HELEN ST., THEN ALONG THE SOUTH R/W OF HOLLY ST. EAST TO THE EXIST. CROSS-DRAIN UNDER 158 BYPASS. (ROADSIDE SWALES WILL DRAIN PONDED WATER ALONG STREETS TO THE NEW PIPE SYSTEM.)
	48.	EXIST. DITCH FROM TENTH ST. EAST TO SECOND ST. HAS HEAVY VEGETATION IN FLOWLINE CAUSING RESTRICTIONS IN DRAINAGE & UNECESSARY BUILD-UP OF TRASH & DEBRIS AT INLETS OF STREET CROSSINGS.	PROVIDE MAINTENANCE ON A REGULARLY SCHEDULED BASIS ON DITCHES TO ELIMINATE THE LARGE BRUSH & SMALL TREES EXISTING IN THE DITCH NOW.
	49. (Photo 14)	APPARENTLY A SEPTIC TANK DRAINS INTO THE EXIST. DITCH BETWEEN THIRD ST. & FOURTH ST.	HAVE THE APPROPRIATE HEALTH OFFICIALS LOOK AT THIS AREA AND MAKE RECOMMENDATIONS.
	50.	EXIST. 43" X 27" CMP UNDER RTE. 158 BYPASS SILTED FULL. (D-12)	TO BE CLEANED OUT AS A PART OF WHISPERING PINES PROJECT (PROBLEM # 47).

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

RAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
0-2	51.	WRIGHTSVILLE AVE. & HOLLY ST. HAS ONLY A PARTIAL CULVERT UNDER CLAY STREET, CAUSING DRAINAGE TO CROSS TOP OF STREET, ERODING STREET & SILTING DITCH DOWNSTREAM.	INSTALL 40'-24" CMP UNDER WRIGHTSVILLE AVE. CLEAN-OUT SILT JUST EAST OF STREET.
	52.	DOUBLE LINE OF 15" CMP SILTED AND RESTRICTS FLOW TO OCEAN OUTFALL.	REPLACE WITH A SINGLE LINE OF 24" CMP TO GIVE A LARGE SINGLE BARREL FOR BETTER FLOW AND ALSO FOR EASIER CLEAN-OUT.
	53.	PONDING EAST OF RTE. 158 BYPASS IN VICINITY OF "OUTER BANKS MOTOR LODGE".	NO CONVENIENT OUTLET TO DRAIN TO. CONSIDER USE OF AN INFILTRATION TRENCH AND/OR USING A PERMEABLE PAVEMENT SURFACE SUCH AS "TURFSTONE".
0-3	54. (Photos 9, 10, & 13)	EAST PORTION OF "OCEAN ACRES" = PONDING IN YARDS, STREETS CAUSING ACCELERATED STREET DAMAGE.	THIS PORTION OF OCEAN ACRES IS DESIGNED TO DRAIN TO A PROPOSED STUB PIPE SOUTH OF OCEAN ACRES DR. ON THE D.O.T. DRAINAGE SYSTEM FOR THE RTE. 158 BYPASS IMPROVEMENTS. THIS WILL BE ACCOMPLISHED BY USING ROADSIDE SWALES & CULVERTS AT STREET APPROACHES & PRIVATE DRIVES. (PROPERTY OWNERS WILL NEED TO DRAIN THEIR YARDS TO THE FRONT.)

(D-13)

FIGURE D

SUMMARY OF PROBLEM AREAS WITH PROPOSED SOLUTIONS

DRAINAGE BASIN	PROBLEM REF. NO.	DESCRIPTION OF PROBLEM AREAS	PROPOSED SOLUTIONS TO PROBLEMS
0-3	55. (Photo 34)	PONDING ON OR NEAR THE EXIST. R/W ALONG RTE. 158 BYPASS FROM PINE GROVE TO LAKE DR.; (EAST & WEST SIDES).	A WIDENING PLAN IS UNDERWAY FOR RTE. 158 BYPASS FROM PINE GROVE TRAIL TO NAGS HEAD. THE DRAINAGE PLANS FOR THIS PROJECT INCLUDE PIPE STUB-OUTS IN LOW AREAS TO ELIMINATE PONDING WATER.
	56. (Photo 40)	EROSION AT NORTHWEST CORNER OF KENTUCKY FRIED CHICKEN; UTILITY POLE IN DRAINAGE PATH.	USE A CONCRETE SWALE TO CHANNEL RUN-OFF AROUND UTILITY POLE TO PREVENT EROSION & SILT DOWNSTREAM.
	57. (Photos 16, & 18)	SAND FILL WEST OF BUSINESS RTE. 158, ACROSS FROM "TANYA'S OCEAN HOUSE", BLOCKED DRAINAGE DITCH TO INLET TO THE EXIST. OCEAN OUTFALL.	AREA FROM 8TH ST. NORTH TO THE EXIST. OCEAN OUTFALL DEPENDS ON AN OPEN DITCH TO THE OUTFALL. RELOCATE DITCH ALONG FRESH POND DR. NORTH SIDE, THEN ALONG WEST SIDE OF BUSINESS RTE. 158 TO THE EXIST. OR "NEW" OUTFALL BY D.O.T. (# 58).
	58. (Photos 19, 29, & 30)	EXIST. OCEAN OUTFALL UNDERNEATH "TANYA'S OCEAN HOUSE" MOTEL CONTINUALLY BURIED BY SAND FROM N.-E. STORMS, AND ALSO IT IS ON LAND WITHOUT AN EASEMENT. (OUTFALL IS NOT ON PILINGS OR EXTENDED INTO OCEAN.)	D.O.T. PLANS TO ADD A NEW OCEAN OUTFALL IN THE R/W OF LAKE DRIVE ON EAST SIDE OF BUSINESS RTE. 158. (SIZE & MAT'L. = 36" SINGLE LINE OF RCP ON PILINGS EXTENDED INTO OCEAN.)

(D-14)

APPENDIX E

References

1. A Summary Report - Southeast Conference on Urban Storm Water Management, at North Carolina State University, April, 1979 Prepared by David H. Howell, Published by Water Resources Research Institute, The University of North Carolina.
2. Design and Construction of Sanitary and Storm Sewers, ASCE Manuals and Reports on Engineering Practice - No. 37, 1974.
3. Design of Exfiltration Trench Systems for Underground Disposal of Storm Water Runoff by Darrell E. McQueen, P.E. Briston, Childs and Associates, Inc., Coral Gables, Fla. May, 1979.
4. Engineering Field Manual for Conservation Practices, U.S. Department of Agriculture, Soil Conservation Service, April, 1975.
5. Flood Insurance Rate Map - Kill Devil Hills, North Carolina, No. 375353 A - U.S. Department of Housing and Urban Develop.
6. Guidelines for Control of Erosion and Sediment During Construction, North Carolina Department of Transportation, July 1, 1980.
7. Handbook of Design for Highway Surface Drainage Structures, prepared by Bridge Location & Hydrographic Department, C.R. Edgerton, State Hydrographic Engineer, 1973.
8. Hydrology, Section 4, SCS National Engineering Handbook, U.S. Department of Agriculture, Soil Conservation Service, August, 1972.
9. Practices in Detention of Urban Stormwater Runoff, American Public Works Association Special Report No. 43, 1974.
10. Proceedings of a Workshop - North Carolina Workshop on Management of Stormwater, Sedimentation, and Flood Control in Urban Areas, January 5, 1978, published by Water Resources

- Research Institute of The University of North Carolina.
11. Roadway Standard Drawings, State of North Carolina, Department of Transportation, Division of Highways Roadways Design Unit, July 1, 1978.
 12. Sedimentation Control, Chapter 4, Title 15, North Carolina Administrative Code, January 11, 1978.
 13. Standards and Specification for Roads and Structures, North Carolina Department of Transportation July 1, 1978.
 14. Stormwater Management Alternatives, J. Tourbier and R. Westmacott, Editors, Water Resources Center, Univeristy of Delaware, April, 1980.
 15. Subdivision Roads - Minimum Construction Standards, North Carolina Department of Transportation July 1, 1979.
 16. Town of Nags Head Surface Water Drainage Plan, Coastal Consultants, LTD and McDowell-Jones, P.A., June 30, 1980.
 17. Underground Disposal of Storm Water Runoff, Design Guidelines Manual, by Joseph B. Hannon, P.E., U.S. Department of Transportation, Federal Highway Administration (FHWA - TS-80-218) February, 1980.
 18. Urban Hydrology for Small Watersheds, Technical Release No. 55, United States Department of Agriculture, Soil Conservation Service, January, 1975.
 19. Various Soil Surveys, Dare County, North Carolina, United States Department of Agriculture, Soil Conservation Service, Various Dates.
 20. Water Quality and Urban Stormwater, A Management Plan, Division of Environmental Management, North Carolina Department of Natural Resources and Community Development, July, 1979.

